GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-Focused Outcome-based Green Curriculum-2021 (COGC-2021)
Semester -V

Course Title: Mobile Computing and Networks
(Course Code: 4351602)

Diploma programme in which this course is offered	Semester in which offered
Information Technology	5th Semester

1.   RATIONALE

In this course students will learn about types of networks, protocols, and essential addressing systems (Subnetting and supernetting). It covers the basic underlying concepts and techniques recently used in the IT industry. The course will cover various aspects of mobile computing and networks, including the fundamental concepts of mobile devices, wireless communication technologies. In today's digital age, mobile computing has become an essential component of our daily lives. People rely on mobile devices to access information, communicate with others, and conduct business transactions. Therefore, the course will equip students with the necessary skills and knowledge to manage mobile computing and networks effectively. Furthermore, the course will also provide students with a basic understanding of the latest trends and developments in mobile computing and networks, including emerging technologies such as 5G and 6G.

2.   COMPETENCY

The purpose of this course is to help the student to attain the following industry identified competency through various teaching-learning experiences:

- **Use the latest mobile technology to manage networks.**

3.   COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge, and the relevant soft skills associated with this competency are to be developed in the student to display the following COs:

The student will develop underpinning knowledge, adequate programming skills of competency for implementing various applications using python programming language to attain the following course outcomes.

a) Differentiate OSI and TCP/IP models.
b) Compare IPv4 and IPv6 addressing schemes.
c) Understand the concepts of Mobile Computing.
d) Explain end to end packet delivery using TCP for mobile network.
e) Understand the emerging trends in mobile communication.

4.   TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
3	-	2	4	30	70	25	25	150

(*): Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessing the attainment of the cognitive domain UOs required for the attainment of the COs.

Legends: L-*Lecture;* **T** *– Tutorial/Teacher Guided Theory Practice;* **P** *-Practical;* **C** *– Credit,* **CA** *- Continuous Assessment;* **ESE** *-End Semester Examination.*

5.   SUGGESTED PRACTICAL EXERCISES

The following practical outcomes (PrOs) are the subcomponents of the COs. . . . These PrOs need to be attained to achieve the COs.

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
1	Test and implement client-server network.(Using Cisco packet tracer)	1	02
2	Test and implement peer to peer networks. (Using Cisco packet tracer)	1	02
3	Download and install wireshark.	1	02
4	Analyze the TCP packets using wireshark.	1	02
5	Determine valid IPv4 address from below. If it is a valid IPv4 address then find its class, Network ID and Host ID. If it's an invalid IPv4 address then give a reason. (Faculty can give more problems as shown below) 1) 1.0.4.5 2) 80.54.256.14 3) 11.025.56.8 4) 192.108.102.101 5) 1.100.11100010.10 6) 228.4.10.25.208	2	02
6	Consider any class IP address and propose appropriate subnet masks which have some number of hosts. For example, consider a class 'C' network. Propose appropriate subnet mask, which have 6 subnets with 30, 25, 20, 15, 10, 5 hosts.	2	02

7	7.(a) Consider a class 'C' IP with 192.192.192 as the network ID then identify (i) No. of bits identified from host id and their position (position in 32 bit) (ii) No. of subnets possible and their id's (subnet mask id) (iii) No. of systems per subnet and their range of IP addresses. calculate above three for subnet mask 255.255.255.192 and 255.255.255.193 7.(b) Determine the subnet ID and host ID for the data packet having destination IP address 192.192.192.120 and subnet mask is 255.255.255.240	2	04
8	Determine valid IPv6 address from below. If it is a valid IPv4 address then find its class, Network ID and Host ID. If it's an invalid IPv4 address then give a reason. (Faculty can give more problems as shown below) (a) ::: (b) ::1:: (c) ::g (d) 2001:0db8:85a3:00000:0:8A2E:0370:7334 (e) 2001:0db8:85a3:0000:0000:8A2E:0370:7334:abcd (f) 2001:::1 (g) ::1.2.3.4	2	02
9	Prepare a wireless ad-hoc network and show its working in windows operating system.	3	04
10	Illustrate IP packet delivery in Mobile IP.	4	02
11	Illustrate Agent discovery and agent registration in Mobile IP.	4	02
12	Illustrate Bluetooth protocol stack.	5	02
	Total		**28**

Note

i. More **Practical Exercises** can be designed and offered by the respective course teacher to develop the industry relevant skills/outcomes to match the COs. The above table is only a suggestive list**.**

ii. The following are some **sample** 'Process' and 'Product' related skills (more may be added/deleted depending on the course) that occur in the above listed **Practical Exercises** of this course required which are embedded in the COs and ultimately the competency..

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
1	Regularity	20
2	Problem Analysis	20
3	Development of the Solution	20
4	Testing of the Solution	20
5	Mock viva test	20
Total		**100**

6.   MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

This major equipment with broad specifications for the PrOs is a guide to procure them by the administrators to usher in uniformity of practical in all institutions across the state.

S. No.	Equipment Name with Broad Specifications	PrO. No.
1	Computer system with operating system: Windows 8 or higher Ver., macOS, and Linux, with 4GB or higher RAM,	All
2	Wireshark packet analyzer, Open Source Software, Cisco packet tracer	

7.   AFFECTIVE DOMAIN OUTCOMES

The following *sample* Affective Domain Outcomes (ADOs) are embedded in many of the above-mentioned COs and PrOs. More could be added to fulfill the development of this competencies.
   a) Work as a leader/a team member.
   b) Follow ethical practices.

The ADOs are best developed through the laboratory/field based exercises. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:
   i.   'Valuing Level' in 1st year
   ii.   'Organization Level' in 2nd year.
   iii. 'Characterization Level' in 3rd year.

8. UNDERPINNING THEORY

Only the major Underpinning Theory is formulated as higher-level UOs of *Revised Bloom's taxonomy* in order development of the COs and competency is not missed out by the students and teachers. If required, more such higher-level UOs could be included by the course teacher to focus on the attainment of COs and competency.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at Application and above level)	Topics and Sub-topics

Unit – I
Networking Essential
	1a. Differentiate different models of Network Computing.
	
	1b. Explain OSI Model and TCP/IP of each layer.
	
	1c. Describe Data traffic and Congestion Management.
		1.1 Models of Network Computing
		  - Centralized Computing
		  - Distributed Computing
		  - Collaborative Computing
		1.2 Client Server Network and Peer to Peer Network
		1.3 Need of layered mechanism
		1.4 OSI Model
		  - Responsibilities of each layer
		1.5 TCP/IP Protocol Suite
		  - Comparison of TCP/IP with OSI model
		  - List of Protocols at each layer of TCP/IP and a brief description of each protocol
		1.6 Data Traffic
		  - Traffic descriptor
		  - Traffic profiles
		1.7 Congestion
		  - Network Performance
		1.8 Congestion Control
		  - Open-Loop Congestion Control
		  - Closed-Loop Congestion Control

Unit – II
Protocol and Addressing Scheme
	2a. Explain different protocols of the OSI layer.
	
	2b. Explain IPv4 and IPv6 addressing scheme.
	
	2c. Describe Subnetting and Supernetting of IPv4.
		2.1 ARP,RARP (Introduction)
		2.2 Routing
		  - Types of routing
		  - Routing table
		2.3 SMTP, POP, IMAP (Introduction)
		2.4 Introduction to WWW and HTTP/S
		2.5 Data link layer protocols
		  - Simplest, stop and wait, stop and wait ARQ
		2.6 IPv4 addressing scheme
		  - Classful and classless notations
		  - Ipv4 datagram header
		  - Subnetting and Supernetting
		  - Network address translation
		  - Advantages, Disadvantages

		2.7 IPV6 Addressing - Need for IPv6 migration - IPv6 advantages
Unit– III **Introduction** **to Mobile** **Computing.**	3a. Explain Architecture for Mobile Computing. 3b. Explain Ad Hoc Networks. 3c. Describe Middleware and Gateway. 3d. List out Application of Mobile Computing.	3.1 Evolution of Mobile Computing 3.2 Architecture for Mobile Computing 3.3 Networks (Brief) - Wireless Networks - Ad-hoc networks - Bearer 3.4 Middleware and Gateways (Brief) - Communication middleware - Transaction processing Communication middleware - Behavior management middleware - Communication Gateways 3.5 Application and Services 3.6 Security and Standards
Unit– IV **Mobile** **Network and** **Transport** **Layer**	4a. Explain Packet Delivery, handover management and Location management. 4b. Differentiate Indirect TCP, snooping TCP and Mobile TCP. 4c. Explain TCP over 3.0 G mobile.	4.1 Mobile IP - Goals, assumptions and requirements - Entities and terminology 4.2 Packet Delivery, handover management and Location management 4.3 Registration, Tunneling and encapsulation 4.4 Dynamic host configuration (Introduction) 4.5 Indirect TCP, snooping TCP and Mobile TCP 4.6 TCP over 3.0 G mobile
Unit– V **Technologies** **in Trends**	5a. Explain Architecture of WLAN 5b. Explain Bluetooth 5c. Differentiate 4G, 5G and 6G Mobile Network.	5.1 WLAN - Introduction of WLAN - Architecture of WLAN - Types of WLAN 5.2 WPAN - Introduction of WPAN - Applications in WPAN - Bluetooth, architecture and Bluetooth protocol stack 5.3 Mobile Networks - 4G, 5G, 6G (Introduction, features)

Note: The UOs need to be formulated at the 'Application Level' and above of Revised Bloom's Taxonomy' to accelerate the attainment of the COs and the competency.

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A	Total Marks
I	Networking Essential	8	2	6	2	10
II	Protocol and Addressing Scheme	10	4	8	6	18
III	Introduction to Mobile Computing	8	4	8	4	16
IV	Mobile Network and Transport Layer	10	6	10	0	16
V	Technologies in Trends	6	2	8	0	10
	Total	**42**	**18**	**40**	**12**	**70**

Legends: R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)
__Note__: This specification table provides general guidelines to assist students for their learning and to teachers to teach and question paper designers/setters to formulate test items/questions assess the attainment of the UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary slightly from the above table.

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related *co-curricular* activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:
a) List different types of Network operating system.
b) Undertake micro-projects in teams
c) Give a seminar on any relevant topics.
d) Identify the type of Network in your Institute.
e) Students are encouraged to register themselves in various MOOCs such as: Swayam, edx, Coursera, Udemy etc to further enhance their learning.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:
a) Massive open online courses (*MOOCs*) may be used to teach various topics/subtopics.
b) Guide student(s) in undertaking micro-projects.
c) *'L' in section No. 4* means different types of teaching methods that are to be employed by teachers to develop the outcomes.

d) About **20% of the topics/sub-topics** which are relatively simpler or descriptive in nature is to be given to the students for **self-learning**, but to be assessed using different assessment methods.

e) With respect to **section No.11**, teachers need to ensure to create opportunities and provisions for **co-curricular activities**.

12.   SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be **individually** undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should **not exceed four.**

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain a dated work diary consisting of individual contributions in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than **16 (sixteen) student engagement hours** during the course. The student ought to submit a micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects is given here. This has to match the competency and the COs. Similar micro-projects could be added by the concerned course teacher:

● Build a network simulation to create virtual networks, configure devices (routers, switches, etc.), and simulate data transmission using OSI or TCP/IP protocols. Users should be able to observe the flow of packets through different layers and analyze network performance. (Use cisco packet tracer or wireshark)
● Case study on any one layer of OSI model.
● Case study on different types of Network devices available at each layer.
● Case study on IPv4 Address scheme with subnetting and supernetting. (Faculty can give a network to design in which student has to use subnetting and supernetting)
● Create a simulation of Mobile IP, a protocol that allows mobile devices to maintain continuous connectivity as they move between different networks. The project will involve implementing key components of Mobile IP and demonstrating its functionality in a simulated network environment. [Use NS-3 (Network Simulator 3) or OMNeT++]
● Conduct a comparative analysis of TCP's performance over various mobile networks, including 3G, 4G (LTE), and 5G. Measure and compare TCP performance metrics such as throughput, latency, and packet loss across these networks. Identify the differences and similarities in TCP behavior and evaluate the challenges specific to TCP over 3G.
● Presentation on different WLAN standards.
● Present different WPAN standards.
● Case study on GSM architecture.
● Case study on 4G architecture.

13.   SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	Data Communication & Networking	Forouzan	Tata McGraw Hill
2	Computer Networks	Andrew S Tannebaum & David J Wetherall	Pearson, 2012
3	Wireless Communications & Networks,	William Stallings	Pearson
4	MOBILE COMPUTING: TECHNOLOGY APPLICATIONS AND SERVICE CREATION, 2ND EDN	Asoke K Talukdar	Tata McGraw Hill
5	Mobile communication	Rappaport	PHI
6	Mobile Communication	Jochen Schiller	Pearson

14.   SOFTWARE/LEARNING WEBSITES

a. http://vlabs.iitkgp.ernet.in/ant/
b. https://www.netacad.com/courses/packet-tracer
c. https://www.wireshark.org/
d. https://youtu.be/lb1Dw0elw0Q
e. https://youtu.be/OU-A2EmVrKQ
f. https://youtu.be/lb1Dw0elw0Q
g. https://docs.oracle.com/cd/E19455-01/806-7600/6jgfbep0v/index.html
h. https://hub.packtpub.com/understanding-address-spaces-and-subnetting-in-ipv4-tutorial/
i. https://subnetipv4.com/
j. https://web.cs.wpi.edu/~cs4514/b98/week3-dllprot/week3-dllprot.html
k. https://www.scaler.com/topics/computer-network/data-link-layer/
l. https://www.tutorialspoint.com/gsm/gsm_architecture.htm
m. https://mobilepacketcore.com/lte-4g-network-architecture/

15.   PO-COMPETENCY-CO MAPPING

Semester V	Mobile Computing and Networks (Course Code: 4351602)						
	POs and PSOs						
Competency & Course Outcomes	PO 1 Basic & Discipline specific knowledge	PO 2 Problem Analysis	PO 3 Design/ development of solutions	PO 4 Engineering Tools, Experimentation & Testing	PO 5 Engineering practices for society, sustainability & environment	PO 6 Project Management	PO 7 Life-long learning
Competency Use the latest mobile technology to manage networks.							
Course Outcomes CO a) Differentiate OSI and TCP/IP models.	2	2	1	1	-	-	2
CO b) Compare IPv4 and IPv6 addressing schemes.	2	2	2	2	-	-	2
CO c) Understand the concepts of Mobile Computing.	3	2	2	2	-	-	2
CO d) Explain end to end packet delivery using TCP for mobile network.	2	2	1	1	-	-	2
CO e) Understand the emerging trends in mobile communication.	3	1	-	-	-	-	2

Legend: '**3**' for high, '**2**' for medium, '**1**' for low or '**-**' for the relevant correlation of each competency, CO, with PO/ PSO

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

Sr. No.	Name and Designation	Institute	Email
1	Mr. Manoj P. Parmar - Head(IT)	Lukhdhirji Engineering College (Diploma), Morbi	manojec@gmail.com
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